## REMARKS/ARGUMENTS

Claims 1-26 were previously pending in this Application. Each of claims 1-26 was rejected. Claims 1, 5, 8, 10-12, 17-20 and 24 are hereby amended and claims 13 and 21 cancelled.

Applicants respectfully request re-examination, reconsideration and allowance of each of presently pending claims 1-12, 14-20 and 22-26.

### I. Claim Rejections Under 35 U.S.C. § 102

In numbered section 2 of the subject Office Action, claims 1-3, 5-16 and 19-25 were rejected under 35 U.S.C. § 102(e) as being anticipated by Battal et al. (U.S. 2005/0026542 A1), hereinafter "Battal". Applicants respectfully submit that these claim rejections are overcome for reasons set forth below.

Briefly and in summary, the Battal reference is directed to accurately determining endpoint of a refractory metal barrier layer film formed over a dielectric surface, directly under a conductive film, and within trenches that extend down from the dielectric surface. In addition to detecting endpoint of the polishing operation used to planarize a product substrate, Battal is also directed to preventing "dishing" of the conductive material formed in the trenches. The Battal reference is used to completely remove a composite layer of a conductive film formed over a barrier material and requires further underlying metallic materials to monitor the extent of polishing that has taken place. Battal is, in summary, directed to monitoring the *polishing process*. Battal takes readings along a single radial direction using stationary sensors and approximates the condition on the wafer surface since wafers "generally have bands that planarize at approximately the same rate", Battal, pp. [0048].

Applicants' invention, in contrast, is directed to monitoring the smoothness or surface irregularities of a semiconductor substrate. The invention uses a polishing process that highlights the anomalies in the semiconductor substrate surface. Applicants' invention identifies high and low topographic locations of the substrate by

distinguishing between locations on a substrate that (a) include the presence of a single metal film formed over the substrate surface, and (b) are marked by the absence of any metallic material. The present invention is not directed to endpointing a polishing operation accurately but rather to using an incompletely removed metal film to identify unacceptably high non-uniformities in the planarity of the semiconductor substrate. The present invention scans the substrate at multiple locations and in multiple directions including non-radial directions, to identify these high and low spots. Burrs or other localized anomalies may exist at various random locations on the semiconductor substrate in the present invention identifies these using two-dimensional mapping, rather than approximations or extrapolations.

Referring now to the claims, claims 1, 19 and 20 are the independent claims in this application. Each of claims 1 and 19 recites the following features:

> forming a non-metallic film over a metal-free substrate;
>
> forming a single [metal claim 1/reflective claim19] film over said non-metallic film, said [metal/reflective] film not being a refractory metal;
>
> and
>
> distinguishing first regions in which said metal film remains, from second regions in which said metal film has been removed and said non-metallic film is exposed, by directing a beam of an optical signal to **scan** across a top surface of said substrate at a plurality of locations and in a plurality of arcuately spaced directions.

Claim 20 is an independent apparatus claim that recites the features of:

> means for **scanning** a plurality of beams of an optical signal across a top surface of said substrate at a plurality of locations and at a plurality of different directions; and
>
> detecting means for detecting a presence or absence of any reflective material at a plurality of arcuately spaced, non-linear locations of said substrate.

Each of these independent claims is distinguished from Battal.

Independent claims 1 and 19 each recite forming a "non-metallic film over a metal-free substrate" and independent claim 20 recites "detecting a presence or absence of any reflective material at a plurality of . . . locations of said substrate". Independent claim 20 therefore inherently recites what is explicitly recited in claims 1 and 19, i.e. that the metal or reflective film being monitored, is formed over a substrate that is metal-free and that there is therefore no metal underneath the metal/reflective layer being polished. This distinguishes each of the independent claims from Battal because Battal requires an underlying reflective material to perform his measurements – "a third reflectance spectra corresponds to light reflected predominantly from the underlying layer of material", Battal pp. [0010]. Independent claims 1, 19 and 20 are therefore distinguished from Battal.

Independent claims 1 and 19 are further distinguished from Battal because each of these claims recites a single metal/reflective film over the substrate and Battal further requires the formation of a plurality of reflective films, i.e. a composite metal structure. FIG. 2 of Battal illustrates a metal film formed over a barrier layer. This is also illustrated in FIG. 1. Claims 14 and 19 are therefore further distinguished from Battal.

Each of independent claims 1 and 19 are further distinguished from Battal because each of these claims recites that the metal/reflective film is not a refractory metal. The reference of Battal is limited to performing the monitoring operation on the barrier layer - refractory metal film disposed beneath the copper interconnects (referring to FIGS. 1 and 2 of Battal) and is limited to directing endpoint which is approached after the superjacent conductive film 202 has been removed and when the barrier/refractory metal film is clearing. Battal recites, in pp. [0025], "end-point detection and monitoring is required for barrier layer 203 during a CMP step . . . . This may result in non-uniform clearing of barrier layer 203". The claimed invention is directed to using a metal/reflective film to determine irregularities of the substrate itself and is therefore

distinguished from using determining endpoint of a refractory film being polished. Claims 1 and 19 are further distinguished from Battal.

Each of independent claims 1, 19 and 20 are further distinguished from Battal because Battal is limited to using *fixed* sensors at different radial distances from the center of the substrate. The sensors also appear to be along the same radial direction. In contrast, the claimed invention provides for scanning. Moreover, Battal does not disclose disposing his sensors at arcuately spaced locations and there would be no suggestion to do so since the substrate (wafer) is apparently rotating when the measurements are being carried out. The present invention, in contrast, provides for *scanning* in a plurality of arcuately spaced directions, in claims 1 and 19, and for scanning a plurality of beams at a plurality of locations and at a plurality of non-opposite directions, in claim 20. Each of independent claims 1, 19 and 20 are therefore further distinguished from Battal.

It is **because** of this scanning feature in multiple directions, that a two-dimensional map of a substrate surface can be accurately generated. From this map, Applicants' invention provides the advantage of identifying unacceptable surface irregularities since the non-metallic film formed over the metal-free substrate has a top surface topography indicative of the topography of the substrate being analyzed. A shortcoming of Battal is that there is no scanning and Battal must approximate the state of an entire concentric band of the substrate. Battal is therefore not capable of detecting local surface irregularities. Moreover, Battal does not even suggest the need to do this since Battal is simply directed to determining when the barrier layer "clears" in order to declare endpoint condition.

Each of independent claims 1, 19 and 20 therefore recites multiple features that distinguish Applicants' invention from Battal and therefore the rejection of claims 1, 19 and 20 under 35 U.S.C. § 102(e), should be withdrawn. Claims 2, 3, 5-12 and 14-16 each depend from claim 1 and are similarly distinguished. Claims 22-25 are also

similarly distinguished based on their dependency from independent claim 20. Claims 13 and 21 have been cancelled.

As such, the rejection of claims 1-3, 5-12, 14-16 and 19, 20 and 22-25 under 35 U.S.C. § 102(e) as being anticipated by Battal, should be withdrawn.

II. **Claim Rejections Under 35 U.S.C. § 103**

In numbered section 4 of the Office Action, claims 4, 17-18 and 26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Battal as applied to claims 1, 3 and 25 and further in view of Official Notice. Applicants respectfully submit that these claim rejections are overcome for reasons set forth below. Claims 4, 17 and 18 depend from claim 1 which is distinguished from Battal for reasons set forth above and claim 26 depends from claim 20, similarly distinguished from Battal for reasons set forth above. The Examiner's Official Notice of practices in semiconductor processing do not cure the above deficiencies of Battal and therefore claims 1 and 20 remain distinguished from Battal. Dependent claims 1, 17, 18 and 26 are therefore similarly distinguished by reason of their dependency.

The rejection of claims 4, 17, 18 and 26 under 35 U.S.C. § 103(a) should therefore be withdrawn.

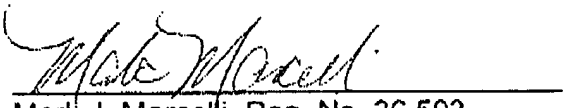
## CONCLUSION

Based on the foregoing, each of pending claims 1-12, 14-20 and 22-26 is in allowable form and the application in condition for allowance, which action is respectfully and expeditiously requested.

The Assistant Commissioner for Patents is hereby authorized to charge any fees or credit any excess payment that may be associated with this communication to Deposit Account 04-1679.

Respectfully submitted,

Dated: February 15, 2006



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